PATENT ABSTRACTS OF JAPAN

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(54) SOLAR CELL

(57)Abstract:
PROBLEM TO BE SOLVED: To dissolve the problems of a cell such as the increase in resistance loss, which is generated with an increase in the area of a cell, such as a warpage of the cell, a crack in the cell or separation of electrodes which is generated by the thick formation of a copper foil on a busbar part, which is a countermeasure against the augmentation in the resistance loss.
SOLUTION: This solar cell has a substrate, wherein a front electrode 5 consisting of a busbar part and a finger part is formed on the side of the main surface on one side of the main surfaces of a semiconductor substrate 1 having a semiconductor joint, a plurality of solar cell elements formed with a rear electrode 7 are provided on the side of the other main surface of the substrate 1 and the electrode 7 of the plurality of these solar cell elements and the electrode 5 are connected with other through a lead wire 9. In this case, the electrode 5 is provided on the busbar part by bonding a copper foil to the busbar part, and the lead wire 9 is connected with the electrode 5 from the middle part of the electrode 5 in the lengthwise direction of the copper foil.

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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The surface electrode which changes from the bus bar section and the finger section to the 1 principal-plane side of the semi-conductor substrate which has semiconductor junction is formed. In the solar-battery equipment which prepared two or more solar battery elements in which the rear-face electrode was formed, and connected two or more of these surface electrodes and rear-face electrodes of a solar battery element to other principal plane side with lead wire Solar-battery equipment characterized by having joined and prepared copper foil in the bus bar section of said surface electrode, and connecting said lead wire to this copper foil from a part middle [in that die-length direction].
[Claim 2] Solar-battery equipment according to claim 1 characterized by joining said copper foil to the bus bar section of said surface electrode by two or more places.
[Claim 3] Solar-battery equipment according to claim 1 or 2 characterized by connecting by joining said lead wire to said copper foil by two or more places.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the solar-battery equipment to which two or more solar battery elements were especially connected by lead wire about solar-battery equipment.
[0002]
[Description of the Prior Art] Conventional solar-battery equipment is shown in drawing 4 . For 11, as for a surface electrode and 16 (16a), a silicon substrate and 15 (15a) are [a rear-face electrode and 18] lead wire among drawing 4 . The N type field 12 and the P type field 13 are in a silicon substrate 11. A surface electrode 15 (15a) is formed in the front face of the N type field 12, and the rear-face electrode 16 (16a) is formed in the front face of the P type field 13. This surface electrode 15 consists of bus bar section 15a for lead-wire connection, and finger section 15b for current collection. Moreover, the rear-face electrode 16 also consists of bus bar section 16a and the finger section (un-illustrating). In order to make resistance loss small, copper foil is made with the pewter bus bar section 16a of the rear-face electrode 16.
[0003] It consists of copper foil etc. and, on the other hand, an edge is arranged covering the abbreviation overall length on a surface electrode 15, by joining two or more of the places to a surface electrode 15, it connects with a surface electrode 15, an another side edge is soldered to the edge of bus bar section 16a of the rear-face electrode 16 through copper foil 17, and the lead wire 18 for connecting two or more solar battery elements is connected to the rear-face electrode 16.
[0004]
[Problem(s) to be Solved by the Invention] With this conventional solar-battery equipment, there was a problem that a generating current increases, bus bar section 15a of a surface electrode 15 became long, therefore resistance loss increased with increase-izing of the cel area of a solar battery element, and conversion efficiency fell.
[0005] Although what is necessary is just to make the cross section of the lead wire 18 of surface electrode 15 part, or the copper foil 17 of rear-face electrode 16 part increase in order to prevent decline in conversion efficiency, the lead wire 18 of surface electrode 15 part must thicken the thickness, and must make the cross section increase, in order to make it not decrease light-receiving area.
[0006] However, when lead wire 18 became thick and this lead wire 18 was welded [15] by the hot air or pewter **, this hot air or heat of pewter ** could not be easily transmitted even to the pewter of surface electrode 15 part, joining of a surface electrode 15 and lead wire 18 took time amount, and there was a problem that the elongation by the thermal expansion of lead wire 18 became large. Where lead wire 18 is extended, when it was joined to the surface electrode 15 and lead wire 18 was shrunken, compressive stress was impressed to the silicon substrate 11, big curvature occurred in the silicon substrate 11, a cel crack, electrode peeling, etc. were induced, and there was a problem that the manufacture yield fell.
[0007] This invention aims at offering the solar-battery equipment which solved problems, such as curvature of the cel generated by thickening increase of the resistance loss which it was made such conventionally in view of the trouble of equipment, and is generated with increase of ** and cel area, and the copper foil of the bus bar section which is the opposite measure, a cel crack, or electrode peeling.
[0008]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, in invention concerning claim 1 The surface electrode which changes from the bus bar section and the finger section to the 1 principal-plane side of the semi-conductor substrate which has semiconductor junction is formed. In the solar-battery equipment which prepared two or more solar battery elements in which the rear-face electrode was formed, and connected two or more of these surface electrodes and rear-face electrodes of a solar battery element to other principal plane side with lead wire Said surface electrode is joined to the bus bar section, copper foil is prepared,

and middle [in that die-length direction], said lead wire is connected to this copper foil from a part.
[0009] It is desirable to join said copper foil to the bus bar section of said surface electrode in the above-mentioned invention at two or more places.
[0010] Moreover, it is desirable to connect by joining said lead wire to said copper foil by two or more places.
[0011]
[Embodiment of the Invention] Hereafter, the operation gestalt of invention concerning claim 1 thru/or claim 3 is explained to a detail based on an accompanying drawing. Drawing 1 is the sectional view and flat surface which show 1 operation gestalt of invention concerning claim 1 thru/or claim 3, and, for 1, as for a surface electrode and 7, a semi-conductor substrate and 5 are [a rear-face electrode and 9] lead wire.
[0012] The semi-conductor substrate 1 consists of single crystal silicon, polycrystalline silicon, etc. with a thickness of about 0.3mm. In this semi-conductor substrate 1, there are an N type field 2 and a P type field 3, and semiconductor junction 4 is formed in the interface part of the N type field 2 and the P type field 3. This N type field 2 is formed in the thickness of about 0.3-0.4 micrometers by making the surface section of the whole silicon substrate 1 diffuse the Lynn atom, and removing the diffusion layer of a lateral portion and a bottom surface part after that by arranging the silicon substrate 1 of P type all over a diffusion furnace, and heating in phosphorus oxychloride (POCl3). In addition, this semi-conductor substrate 1 may be formed by single crystal gallium arsenide etc.
[0013] The surface electrode 5 is formed in the surface part of the N type field 2. This surface electrode 5 consists of finger section 5b which intersected bus bar section 5a for connecting lead wire 9, and this bus bar section 5a, and was formed by branching. Bus bar section 5a is formed in 2 parallel covering the abbreviation overall length of a substrate 1, finger section 5b intersects bus bar section 5b, and the a large number book is formed covering the abbreviation overall length of a substrate 1. Bus bar section 5a is formed in width of face of about 2mm, and finger section 5b is formed in width of face of about 0.2mm. Such a surface electrode 5 screen-stencils the paste which consists of a glass frit, a binder, a solvent, etc., can be burned at the temperature of about 700-800 degrees C, and is formed by covering the whole with a pewter layer for example, in the end of silver dust.
[0014] Copper foil 6 is stuck on this surface electrode 5 (5a). This copper foil 6 is formed in order to enlarge the cross section of a surface electrode 5 (5a) and to lower the electric resistance of a surface electrode 5, and it is formed in width of face of about 2mm, and the thickness of about 0.16mm. Such copper foil 6 is joined by five points at equal intervals on a surface electrode 5. Thus, if a surface electrode 5 and copper foil 6 are joined only by two or more places, even if the die length of copper foil 6 changes with temperature changes, copper foil 6 will not cut or curvature will not be produced in a substrate 1.
[0015] Although not illustrated, the antireflection film which consists, for example of a silicon nitride film etc. is formed in the front-face side of a substrate 1. Such an antireflection film is formed for example, by a plasma-CVD method etc.
[0016] The rear-face electrode 7 is formed in the rear-face side of a substrate 1. This rear-face electrode 7 also consists of the finger section (un-illustrating) by which intersects bus bar section 7a for connecting lead wire 9, and this bus bar section 7a, and a large number book formation is carried out by branching. Bus bar section 7a is formed in 2 parallel covering the abbreviation overall length of a substrate 1, the finger section intersects bus bar section 7a, and the a large number book is formed covering the abbreviation overall length of a substrate 1. Bus bar section 7a is formed in width of face of about 5mm, and the finger section is formed in width of face of about 0.5mm. Since the rear-face side of a substrate 1 does not need to take reduction of light-receiving area into consideration, it can be formed more broadly than bus bar section 5a of a surface electrode 5, and can reduce the resistance loss by the side of the rear-face electrode 7. Such a rear-face electrode 7 screen-stencils the paste which consists of a glass frit, a binder, a solvent, etc., can be burned, and is formed by covering with a pewter layer for example, in the end of silver dust. In addition, the rear-face electrode 7 may be formed all over the rear-face side of not only when it crosses and prepares bus bar section 7a and finger section 7b, but the substrate 1.
[0017] Copper foil 8 is stuck on this rear-face electrode 7. This copper foil 8 is formed in width of face of about 5mm, and the thickness of about 0.1mm. Such copper foil 8 is joined by five points at equal intervals on bus bar section 7a of the rear-face electrode 7. Thus, if copper foil 8 is joined to bus bar section 7a of the rear-face electrode 7 only by two or more places, even if the die length of copper foil 8 changes with temperature changes, copper foil 8 will not cut or curvature will not be produced in a substrate 1.
[0018] Bus bar section 5a of a surface electrode 5 and bus bar section 7a of the rear-face electrode 7 are connected with lead wire 9. This lead wire 9 is easy to be the same as that of the copper foil 6 stuck on a surface electrode 5. That is, it consists of width of face of 2mm, and about [thickness 0.16mm] copper foil. The bus bar section 5a side of the surface electrode 5 in this lead wire 9 is joined by two points, the abbreviation

center section in the die-length direction of bus bar section 5a, and an edge. For example, what is necessary is just to join two laps in all for lead wire 9 and copper foil 6 by die length of about 75mm, if it is the solar battery of 150mm angle. Thus, moreover, resistance loss can be reduced, without producing curvature etc. in a substrate 1, even if a substrate 1 is enlarged to 150mm angle extent if lead wire 9 is joined by two points, the abbreviation center section and edge by the side of bus bar section 5a of a surface electrode 5.
[0019] The rear-face electrode 7 side laps with copper foil 8 about 10-75mm, and joins lead wire 9 to it, for example. This rear-face electrode 7 side joins lead wire 9 by copper foil 8, one point, or two or more points.
[0020]
[Example] While forming the surface electrode 5 which changes from bus bar section 5a and finger section 5b to the front-face side of a substrate 1 The rear-face electrode 7 which changes from bus bar section 7a and the finger section also to a rear-face side is formed. The lead wire 9 which consists of copper foil with a width of face [of 2mm] and a thickness of 0.16mm is joined by five regular intervals points covering the overall length on bus bar section 5a of a surface electrode 5. The output characteristics of the solar battery element of structure and the curvature of a substrate 1 were measured covering the overall length on bus bar section 7a of a rear-face electrode conventionally which joined copper foil 8 with a width of face [of 5mm], and a thickness of 0.1mm by five regular intervals points, and connected lead wire 9 to the edge.
[0021] Moreover, while joining copper foil 6 with a width of face [of 2mm], and a thickness of 0.16mm by five regular intervals points on the surface electrode 5, the output characteristics of the solar battery element of structure and the curvature of a substrate 1 concerning invention of claim 1 which has arranged the lead wire 9 which consists of copper foil with a width of face [of 2mm] and a thickness of 0.16mm from the central part of bus bar section 5a to the edge side, and was joined by two places, the edge near the center section of the bus bar section, were measured. The result is shown in Table 1.
[0022] In addition, as shown in drawing 3 , the thing of loop structure which connected two lead wire 9 by tie rod 9a was used for the edge of lead wire 9. Moreover, the cel property shown in Table 1 performs probe measurement, without attaching copper foil and lead wire to surface electrode 5 and rear-face electrode 7 part.
[0023]
[Table 1]

	J_{SC}(mA/cm^2)	V_{OC}(V)	F.F	Effi(%)	セル反り(mm)
セル特性	30.38	0.594	0.749	13.51	-
従来構造	30.42	0.595	0.722	13.07	0.1
中央取出構造	30.44	0.595	0.728	13.19	0.1

[0024] If it is conventionally made the solar battery of the central fetch structure which starts like claim 1 in the solar battery of structure to the fall of F.F (curvilinear factor) being 3.6% (0.722/0.749) as shown in Table 1, the fall of F.F will be suppressed to 2.8% (0.728/0.749), and conversion efficiency will carry out improvement 0.12% (13.19-13.07). Moreover, the curvature of the cel of the central fetch structure of invention concerning claim 1 is 0.1mm, and was not conventionally different from the thing of structure.
[0025]
[Effect of the Invention] As mentioned above, according to invention concerning claim 1, copper foil is joined and prepared in the bus bar section of a surface electrode, by the increment in the cross section of an electrode section, since the lead wire which connects two or more solar battery elements to this copper foil from the abbreviation central part in that die-length direction was connected, since resistance loss decreases, F.F improves and output characteristics improve. Moreover, since the effect of telescopic motion by the thermal expansion when welding lead wire in order to wire lead wire from the abbreviation center section of the bus bar section serves as half in the direction of a bus bar of a substrate, the curvature of a cel becomes small.
[0026] Moreover, according to invention concerning claim 2, since copper foil is joined to the bus bar section of a surface electrode by two or more places, the curvature of a substrate can be more effectively made small.
[0027] Furthermore, according to invention concerning claim 3, since lead wire is joined to the copper foil by the side of a surface electrode by two or more places, the curvature of a substrate can be more effectively made small.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the solar battery element used for the solar-battery equipment of invention concerning claim 1, and (a) is a sectional view and (b) is a top view.
[Drawing 2] It is drawing showing 1 operation gestalt of the solar-battery equipment of invention concerning claim 1.
[Drawing 3] It is drawing showing the measuring method of the output characteristics of solar-battery equipment.
[Drawing 4] It is drawing showing conventional solar-battery equipment, and (a) is a sectional view and (b) is a top view.
[Description of Notations]
1 [... A rear-face electrode, 8 / ... The copper foil by the side of a rear-face electrode 9 / ... Lead wire] ..... A substrate, 5 ... A surface electrode, 6 ... The copper foil by the side of a surface electrode, 7

[Translation done.]

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審査請求　未請求　請求項の数３　ＯＬ　（全５頁）

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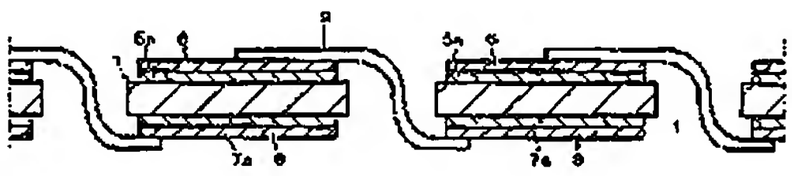
(54)【発明の名称】　太陽電池装置

(57)【要約】
【課題】　セル面積の増大にともなって抵抗損失が増大し、その対向策としてバスバー部の銅箔を厚くすると、セルの反り、セル割れ、或いは電極剥がれが発生するという問題があった。
【解決手段】　半導体接合部を有する半導体基板の一主面側にバスバー部とフィンガー部とから成る表面電極を形成し、他の主面側に裏面電極を形成した複数の太陽電池素子を設け、この複数の太陽電池素子の表面電極と裏面電極とをリード線で接続した太陽電池装置において、前記表面電極をバスバー部に銅箔を接合して設け、この銅箔の長さ方向における途中部分から前記リード線を接続する。



【特許請求の範囲】

【請求項１】　半導体接合部を有する半導体基板の一主面側にバスバー部とフィンガー部とから成る表面電極を形成し、他の主面側に裏面電極を形成した複数の太陽電池素子を設け．この複数の太陽電池素子の表面電極と裏面電極とをリード線で接続した太陽電池装置において、前記表面電極のバスバー部に銅箔を接合して設け．この銅箔にその長さ方向における途中部分から前記リード線を接続したことを特徴とする太陽電池装置。

【請求項２】　前記銅箔を前記表面電極のバスバー部に複数箇所で接合したことを特徴とする請求項１に記載の太陽電池装置。

【請求項３】　前記リード線を前記銅箔に複数箇所で接合することによって接続したことを特徴とする請求項１または請求項２に記載の太陽電池装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は太陽電池装置に関し．特に複数の太陽電池素子がリード線によって接続された太陽電池装置に関する。

【０００２】

【従来の技術】従来の太陽電池装置を図４に示す。図４中．１１はシリコン基板．１５（１５ａ）は表面電極、１６（１６ａ）は裏面電極．１８はリード線である。シリコン基板１１内にはＮ型領域１２とＰ型領域１３とがある。Ｎ型領域１２の表面には表面電極１５（１５ａ）が設けられ、Ｐ型領域１３の表面には裏面電極１６（１６ａ）が設けられている。この表面電極１５はリード線接続用のバスバー部１５ａと集電用のフィンガー部１５ｂとから成る。また、裏面電極１６もバスバー部１６ａとフィンガー部（不図示）とから成る。裏面電極１６のバスバー部１６ａには、抵抗損失を小さくするために銅箔がハンダ付されている。

【０００３】複数の太陽電池素子を接続するためのリード線１８は銅箔などから成り、一方端が表面電極１５上の略全長にわたって配設され、その複数箇所を表面電極１５と接合することによって表面電極１５に接続され、他方端が銅箔１７を介して裏面電極１６のバスバー部１６ａの端部にハンダ付けされて裏面電極１６に接続される。

【０００４】

【発明が解決しようとする課題】この従来の太陽電池装置では、太陽電池素子のセル面積の増大化に伴ない、発生電流が増加したり、また表面電極１５のバスバー部１５ａが長くなり．そのために抵抗損失が増大して変換効率が低下するという問題があった。

【０００５】変換効率の低下を防止するためには．表面電極１５部分のリード線１８や裏面電極１６部分の銅箔１７の断面積を増加させればよいが．表面電極１５部分のリード線１８は、受光面積を減少させないようにするために、その厚みを厚くして断面積を増加させなければならない。

【０００６】ところが、リード線１８が厚くなると、このリード線１８をホットエアーやハンダ鏝で表面電極１５に溶着する際に、このホットエアーやハンダ鏝の熱が表面電極１５部分のハンダまで伝わりにくく、表面電極１５とリード線１８の溶着に時間がかかり、リード線１８の熱膨張による伸びが大きくなるという問題があった。リード線１８が伸びた状態で表面電極１５に接合されると、リード線１８が縮む際に、シリコン基板１１に圧縮応力が印加されて、シリコン基板１１に大きな反りが発生し、セル割れや電極剥がれなどを誘発し．製造歩留りが低下するという問題があった。

【０００７】本発明はこのような従来装置の問題点に鑑みてなされたものであり、セル面積の増大にともなって発生する抵抗損失の増大と．その対向策であるバスバー部の銅箔を厚くすることによって発生するセルの反り、セル割れ、或いは電極剥がれなどの問題を解消した太陽電池装置を提供することを目的とする。

【０００８】

【課題を解決するための手段】上記目的を達成するために．請求項１に係る発明では、半導体接合部を有する半導体基板の一主面側にバスバー部とフィンガー部とから成る表面電極を形成し、他の主面側に裏面電極を形成した複数の太陽電池素子を設け、この複数の太陽電池素子の表面電極と裏面電極とをリード線で接続した太陽電池装置において．前記表面電極をバスバー部に銅箔を接合して設け、この銅箔にその長さ方向における途中部分から前記リード線を接続する。

【０００９】上記発明では．前記銅箔を前記表面電極のバスバー部に複数箇所で接合することが望ましい。

【００１０】また、前記リード線を前記銅箔に複数箇所で接合することによって接続することが望ましい。

【００１１】

【発明の実施の形態】以下．請求項１ないし請求項３に係る発明の実施形態を添付図面に基づき詳細に説明する。図１は請求項１ないし請求項３に係る発明の一実施形態を示す断面図と平面であり、１は半導体基板．５は表面電極、７は裏面電極．９はリード線である。

【００１２】半導体基板１は、厚み０．３ｍｍ程度の単結晶シリコンや多結晶シリコンなどから成る。この半導体基板１内には．Ｎ型領域２とＰ型領域３があり．Ｎ型領域２とＰ型領域３との界面部分で半導体接合部４が形成される。このＮ型領域２はＰ型のシリコン基板１を拡散炉中に配置して、オキシ塩化リン（ＰＯＣｌ３）中で加熱することによって、シリコン基板１の全体の表面部にリン原子を拡散させ、その後に側面部と底面部の拡散層を除去することにより．厚み０．３～０．４μｍ程度に形成する。なお、この半導体基板１は単結晶ガリウム砒素などで形成してもよい。

【００１３】Ｎ型領域２の表面部分には、表面電極５が形成されている。この表面電極５は、リード線９を接続するためのバスバー部５ａとこのバスバー部５ａと交差して分岐して形成されたフィンガー部５ｂとから成る。バスバー部５ａは基板１の略全長にわたって二本平行に形成されており、フィンガー部５ｂはバスバー部５ｂに交差して多数本が基板１の略全長にわたって形成されている。バスバー部５ａは例えば２ｍｍ程度の幅に形成され、フィンガー部５ｂは例えば０．２ｍｍ程度の幅に形成される。このような表面電極５は、例えば銀粉末、ガラスフリット、結合剤、および溶剤などから成るペーストをスクリーン印刷して７００～８００℃程度の温度で焼き付け、全体をハンダ層で被覆することにより形成される。

【００１４】この表面電極５（５ａ）上には銅箔６が貼りつけられている。この銅箔６は、表面電極５（５ａ）の断面積を大きくして表面電極５の電気抵抗を下げるために設けるものであり、幅２ｍｍ程度、厚み０．１６ｍｍ程度に形成される。このような銅箔６を表面電極５上に例えば等間隔に５点で接合する。このように表面電極５と銅箔６とを複数箇所のみで接合すると、温度変化によって銅箔６の長さが変化しても、銅箔６が切断したり、基板１に反りを生じることがない。

【００１５】基板１の表面側には、図示されていないが、例えば窒化シリコン膜などから成る反射防止膜が形成される。このような反射防止膜は例えばプラズマＣＶＤ法などで形成される。

【００１６】基板１の裏面側には裏面電極７が設けられている。この裏面電極７も、リード線９を接続するためのバスバー部７ａとこのバスバー部７ａと交差して分岐して多数本形成されるフィンガー部（不図示）とから成る。バスバー部７ａは基板１の略全長にわたって二本平行に形成されており、フィンガー部はバスバー部７ａに交差して多数本が基板１の略全長にわたって形成されている。バスバー部７ａは例えば５ｍｍ程度の幅に形成され、フィンガー部は例えば０．５ｍｍ程度の幅に形成される。基板１の裏面側は、受光面積の減少を考慮しなくてもよいことから、表面電極５のバスバー部５ａよりも幅広に形成でき、裏面電極７側での抵抗損失を低減できる。このような裏面電極７は、例えば銀粉末、ガラスフリット、結合剤、および溶剤などから成るペーストをスクリーン印刷して焼き付け、ハンダ層で被覆することにより形成される。なお、裏面電極７は、バスバー部７ａとフィンガー部７ｂを交差して設ける場合に限らず、基板１の裏面側の全面に設けてもよい。

【００１７】この裏面電極７上には銅箔８が貼りつけられている。この銅箔８は、幅５ｍｍ程度、厚み０．１ｍｍ程度に形成される。このような銅箔８を裏面電極７のバスバー部７ａ上に例えば等間隔に５点で接合する。このように裏面電極７のバスバー部７ａと銅箔８を複数箇所のみで接合すると、温度変化によって銅箔８の長さが変化しても、銅箔８が切断したり、基板１に反りを生じることがない。

【００１８】表面電極５のバスバー部５ａと裏面電極７のバスバー部７ａをリード線９で接続する。このリード線９は表面電極５上に貼りつけられる銅箔６と同一のものでよい。つまり、幅２ｍｍ、厚み０．１６ｍｍ程度の銅箔で構成される。このリード線９における表面電極５のバスバー部５ａ側は、バスバー部５ａの長さ方向における略中央部と端部の二点で接合される。例えば１５０ｍｍ角の太陽電池であれば、リード線９と銅箔６とを７５ｍｍ程度の長さで重なり合わせて二点を接合すればよい。このように、リード線９を表面電極５のバスバー部５ａ側の略中央部と端部の二点で接合すると、基板１が１５０ｍｍ角程度に大型化しても基板１に反りなどを生じることなく、しかも抵抗損失を低減できる。

【００１９】裏面電極７側はリード線９を銅箔８に例えば１０～７５ｍｍ程度重なり合わせて接合する。この裏面電極７側はリード線９を銅箔８と一点もしくは複数点で接合する。

【００２０】

【実施例】基板１の表面側にバスバー部５ａとフィンガー部５ｂとから成る表面電極５を設けると共に、裏面側にもバスバー部７ａとフィンガー部とから成る裏面電極７を設け、表面電極５のバスバー部５ａ上の全長にわたって、幅２ｍｍ、厚さ０．１６ｍｍの銅箔から成るリード線９を等間隔な５点で接合し、裏面電極のバスバー部７ａ上の全長にわたって、幅５ｍｍ、厚さ０．１ｍｍの銅箔８を等間隔な５点で接合して端部にリード線９を接続した従来構造の太陽電池素子の出力特性と基板１の反りを測定した。

【００２１】また、表面電極５上に幅２ｍｍ、厚さ０．１６ｍｍの銅箔６を等間隔な５点で接合するとともに、幅２ｍｍ、厚さ０．１６ｍｍの銅箔から成るリード線９をバスバー部５ａの中央部分から端部側に配置してバスバー部の中央部近傍と端部の２箇所で接合した請求項１の発明に係る構造の太陽電池素子の出力特性と基板１の反りを測定した。その結果を表１に示す。

【００２２】なお、リード線９の端部は、図３に示すように、二本のリード線９をタイバー９ａで接続したループ構造のものを用いた。また、表１に示すセル特性は表面電極５と裏面電極７部分に銅箔やリード線をつけずに探針測定を行ったものである。

【００２３】

【表１】

	J_{sc}(mA/cm²)	V_{oc}(V)	F.F	Eff(%)	セル反り(mm)
セル特性	30.38	0.594	0.749	13.51	-
従来構造	30.42	0.595	0.722	13.07	0.1
中央取出構造	30.44	0.595	0.728	13.19	0.1

【００２４】表１に示すとおり、従来構造の太陽電池においては、Ｆ．Ｆ（曲線因子）の低下が３．６％（０．７２２／０．７４９）であるのに対して、請求項１のように係る中央取出構造の太陽電池にするとで、Ｆ．Ｆの低下が２．８％（０．７２８／０．７４９）に抑えられ、変換効率が０．１２％（１３．１９－１３．０７）向上する。また、請求項１に係る発明の中央取出構造のセルの反りは０．１ｍｍであり、従来構造のものと変わらなかった。

【００２５】

【発明の効果】以上のように、請求項１に係る発明によれば、表面電極のバスバー部に銅箔を接合して設け、この銅箔にその長さ方向における略中央部分から複数の太陽電池素子を接続するリード線を接続したことから、電極部分の断面積の増加によって、抵抗損失が減少することから、Ｆ．Ｆが向上し、出力特性が向上する。また、リード線をバスバー部の略中央部から配線するため、リード線を溶着するときの熱膨張による伸縮の影響が基板のバスバー方向において半分となるため、セルの反りが小さくなる。

【００２６】また、請求項２に係る発明によれば、銅箔を表面電極のバスバー部に複数箇所で接合することから、基板の反りをより有効に小さくすることができる。

【００２７】さらに、請求項３に係る発明によれば、リード線を表面電極側の銅箔に複数箇所で接合することから、基板の反りをより有効に小さくすることができる。

【図面の簡単な説明】

【図１】請求項１に係る発明の太陽電池装置に用いられる太陽電池素子を示す図であり、（ａ）は断面図、（ｂ）は平面図である。

【図２】請求項１に係る発明の太陽電池装置の一実施形態を示す図である。

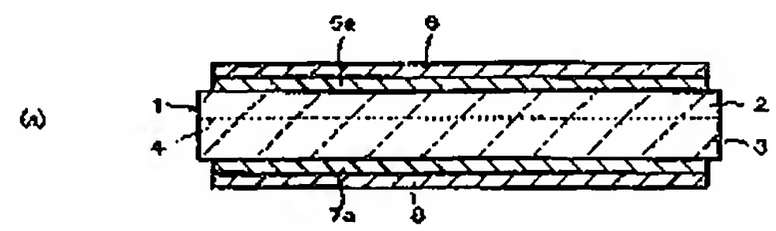
【図３】太陽電池装置の出力特性の測定方法を示す図である。

【図４】従来の太陽電池装置を示す図であり、（ａ）は断面図、（ｂ）は平面図である。

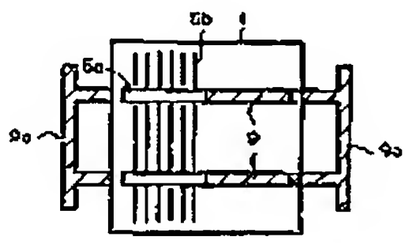
【符号の説明】

１……基板、５……表面電極、６……表面電極側の銅箔、７……裏面電極、８……裏面電極側の銅箔、９……リード線

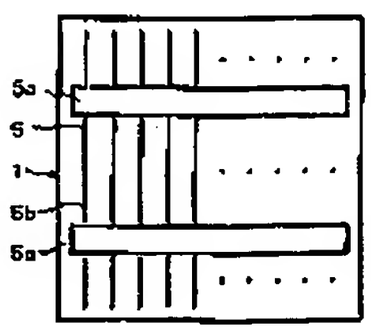
【図１】



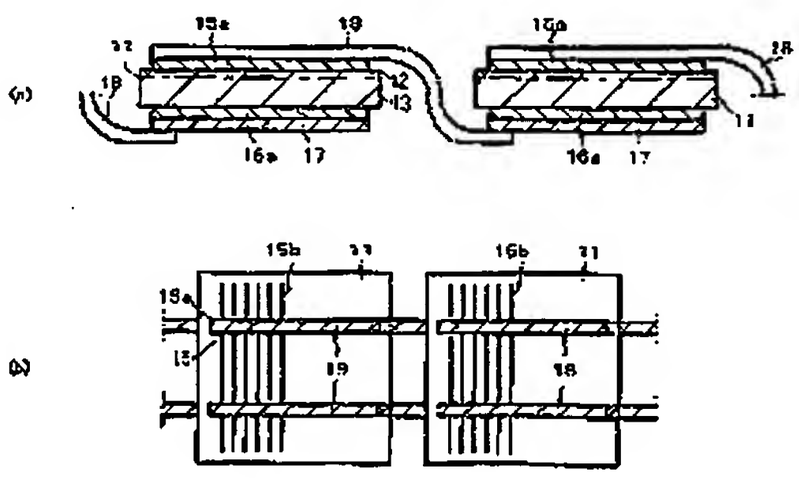
【図３】



【図２】



【図４】



【図２】